Tutorial
H-1000-5332-02-B

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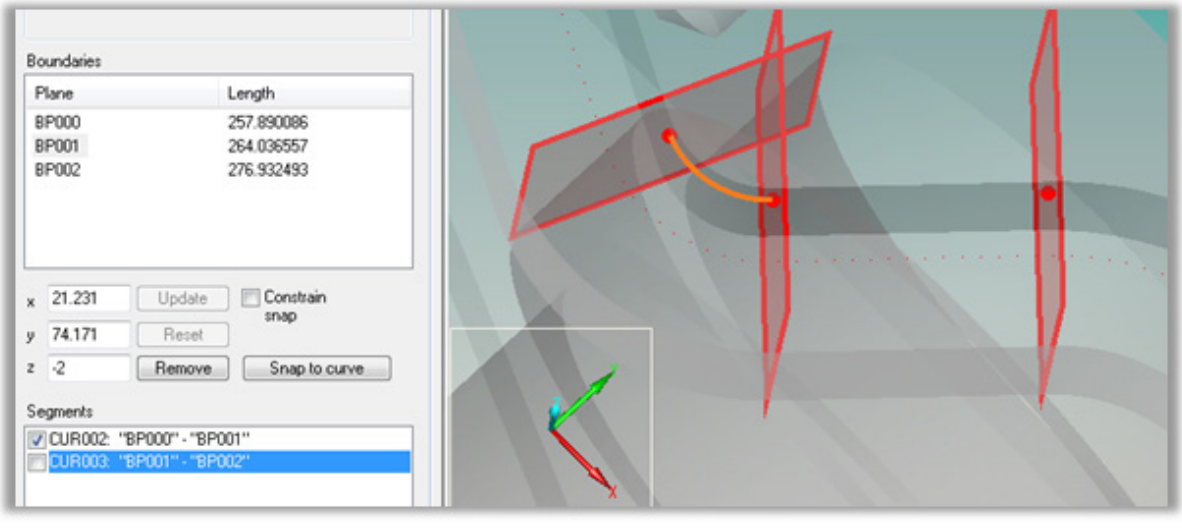
Curve manipulation - trimming



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Curve manipulation - trimming

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1 Curve manipulation - trimming

1.1 Tutorial pre-requisites

- Students should be familiar with the content of the basic tutorials

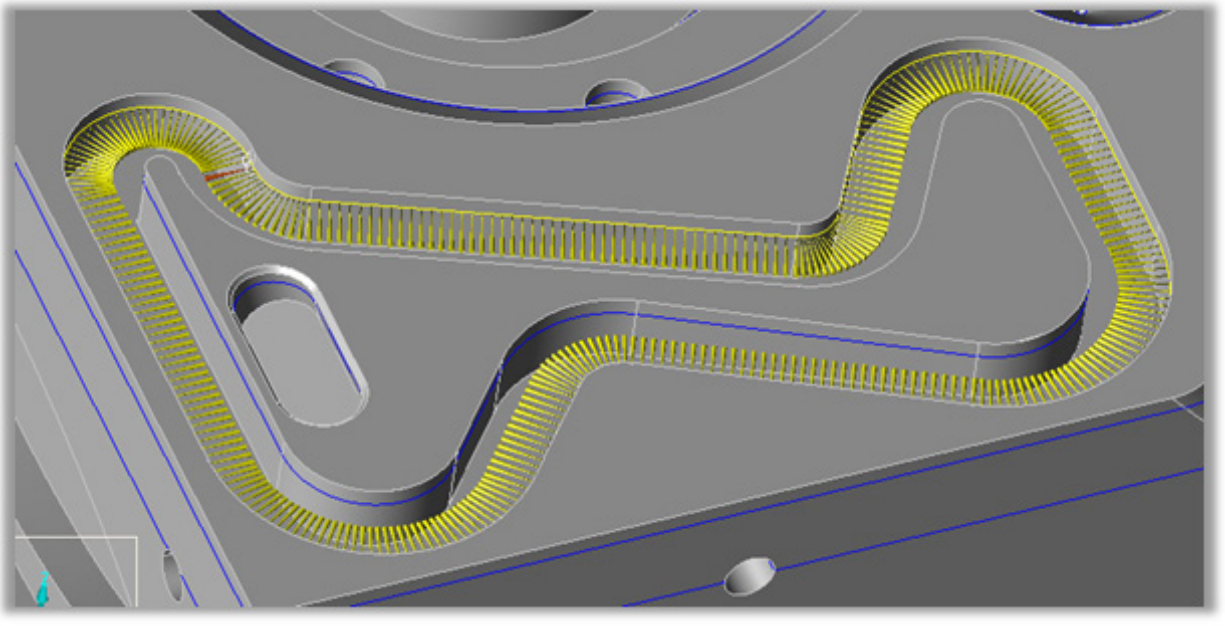
1.2 Tutorial objectives

- Further exposure to feature construction
- Introduction to the use of geometry extraction and construction as a program optimisation method

2 Introduction

MODUS has several techniques for constructing a curve from a previously measured curve. This tutorial will cover the curve construction techniques that use trimming techniques.

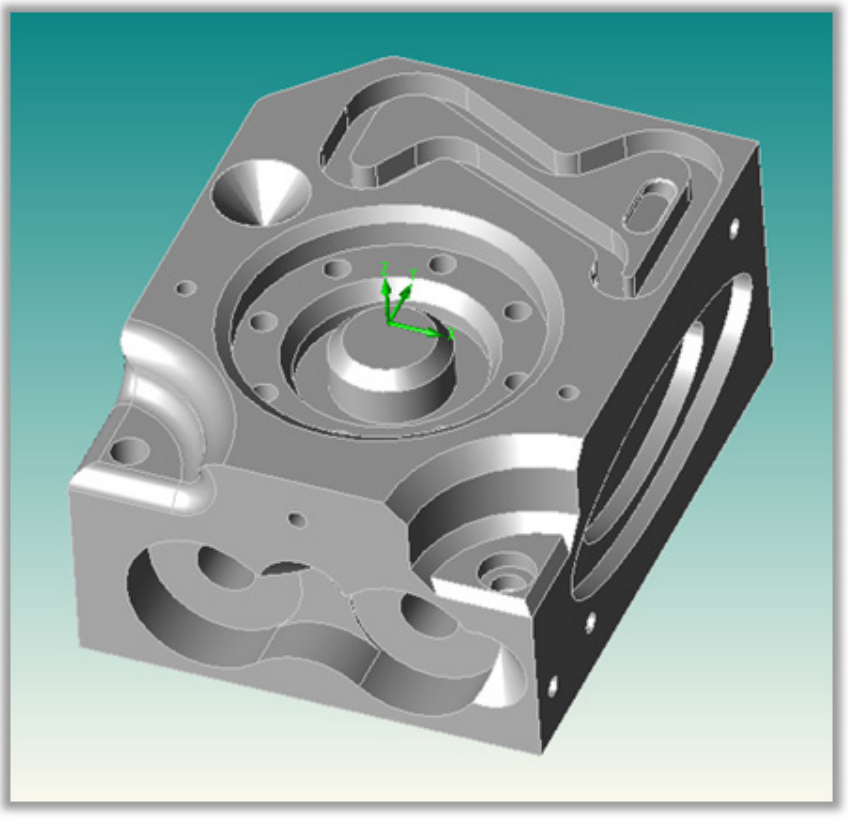
Sometimes it is more efficient or more convenient to measure a complete curve and then cut the curve into smaller segments.



If the arcs and lines were scanned as separate features, it would take a lot of time to measure because the probe would need to move onto and off of the surface several times. By measuring only one scan, the probe only makes contact once, eliminating most of the extra time required to make contact with the part surface.

3 Align the demo block

Use any method to create the datum on the demo block. This tutorial can be done online or offline, using proper techniques so that the CAD model of the block maintains the proper coordinate system such that a curve will have the correct coordinates relative to the model and datum.

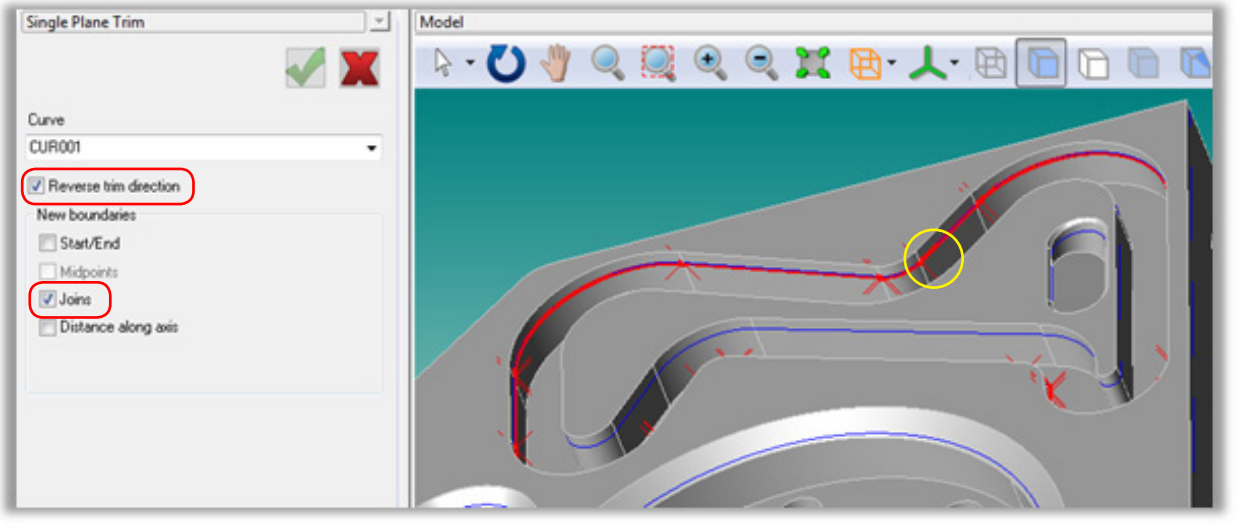


4 Inspect a curve

Inspect a curve such as the race track on top of the demo block. The resulting curve feature will be used to create additional constructed curves. One of the curves that are split from the original scanned curve will be used to construct an ‘ARC’. This ‘ARC’ construction is only one of the many ways to take advantage of the ‘CURVE CONSTRUCT’ methods.

5 Single plane trim

The scan will be trimmed using a single point cutting plane. Be sure to turn on temporary features in 'Model Explorer' so the 'JOIN' points can be seen when selecting a cutting plane.

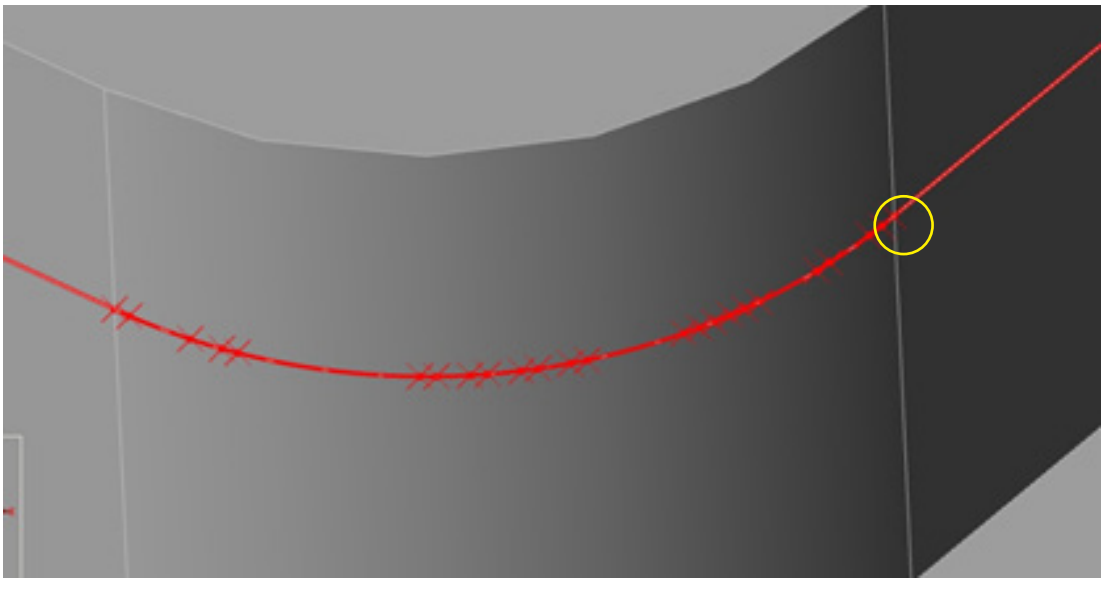


Click: 'Construct', select 'Curve' then click on 'Single Plane Trim'

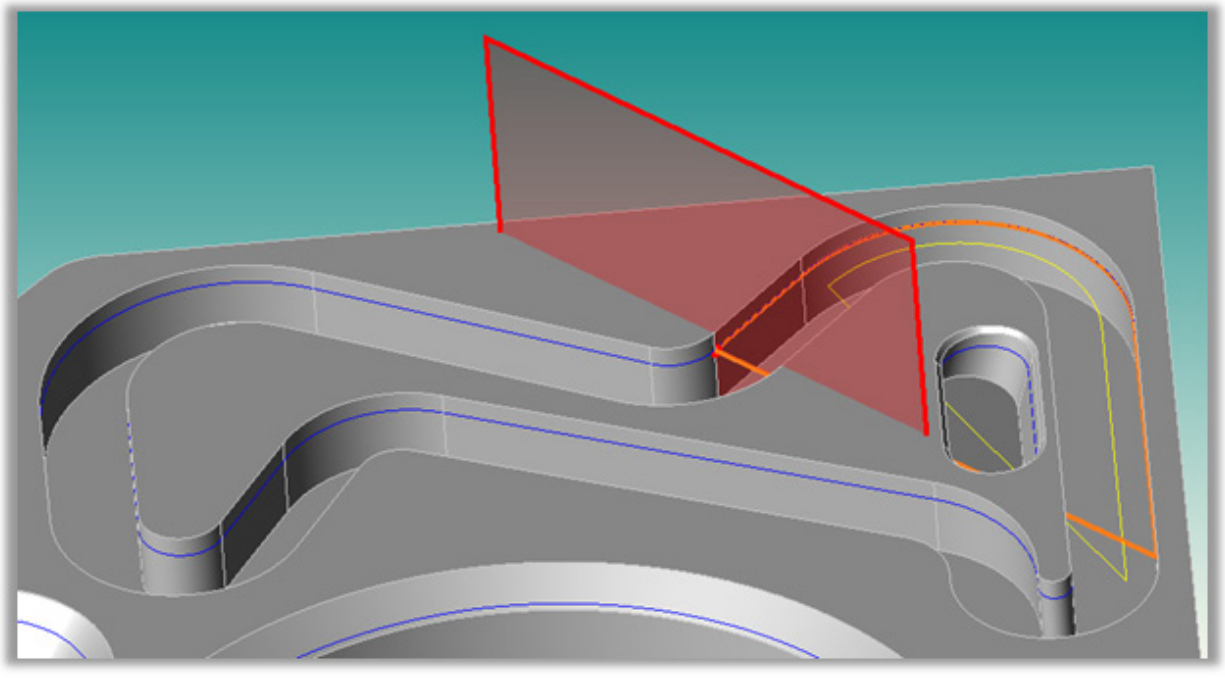
Several options are available in the prompt window.

Click: 'Joins' so that points will appear on the red line wherever segments join e.g. between the lines and arcs.

Click one of the points like the one in the yellow circle in the pictures.



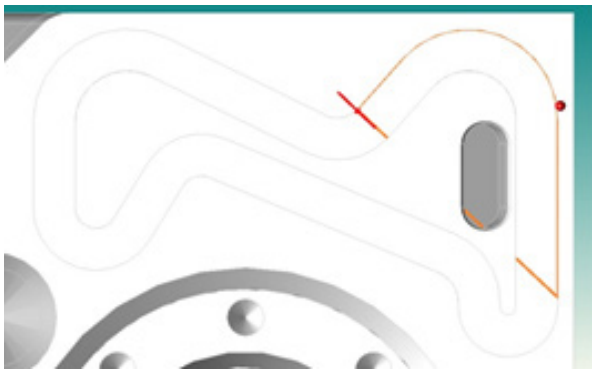
A temporary plane will appear to indicate the place where the curve will be split.



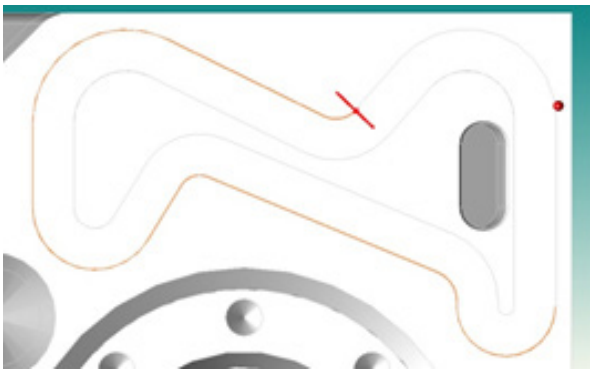
The orange line shows the curve that will be constructed. The plane goes to an infinite length, even though it is shown to be a finite length. Therefore, the curve is split from where the plane crosses the curve in two positions.

Click: 'Reverse trim direction' to see what happens. Note that the other half of the curve will highlight in orange.

Reverse Trim Direction



No Reverse Trim Direction



The nominal DMIS code for the newly constructed curve will not have any nominal data points showing. However, nominal data is available for the constructed feature even though it is not visible in the feature nominal and a tolerance can be applied to output the profile of this trimmed curve.

Sample DMIS code:

F(CUR006)=FEAT/GCURVE,CART,46.364,82.655,-2,0,0,1 ← No PTDATA

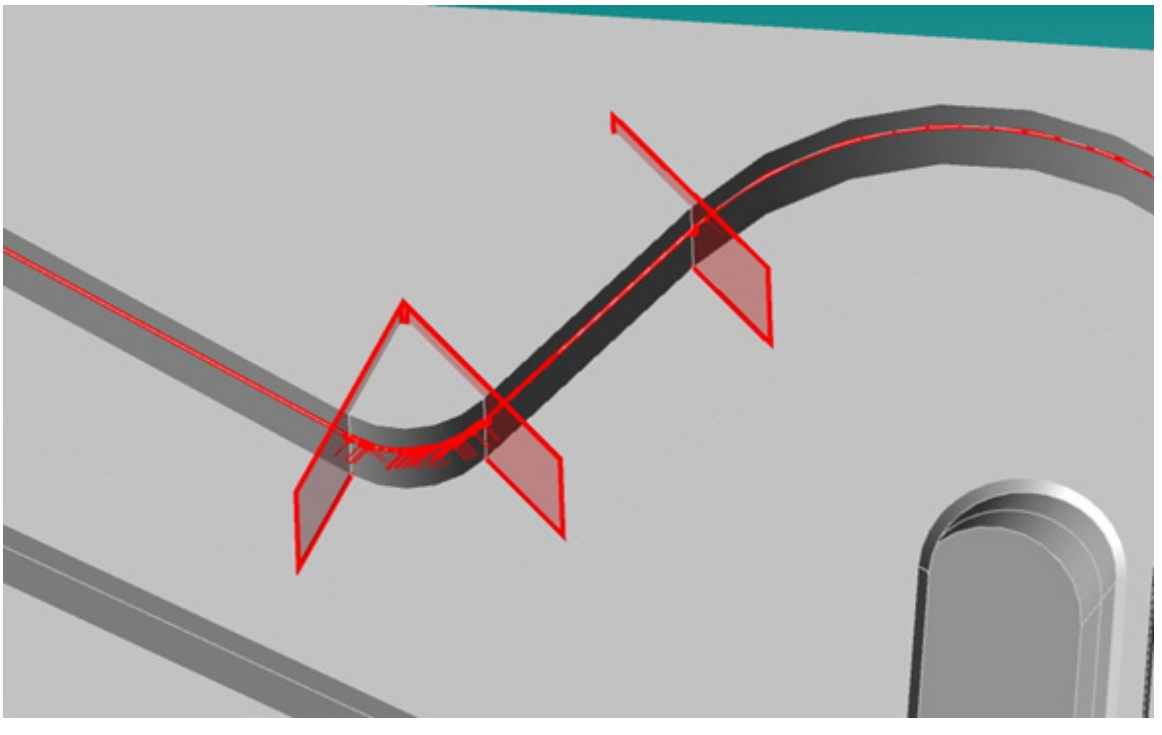
6 Multi plane trim

Multi plane trim is similar to single plane trim, but allows selection of more than one trim plane. This method will be used to create multiple individual curves.

Click: ‘Construct’ then select ‘Curve’ followed by ‘Multi Trim’.

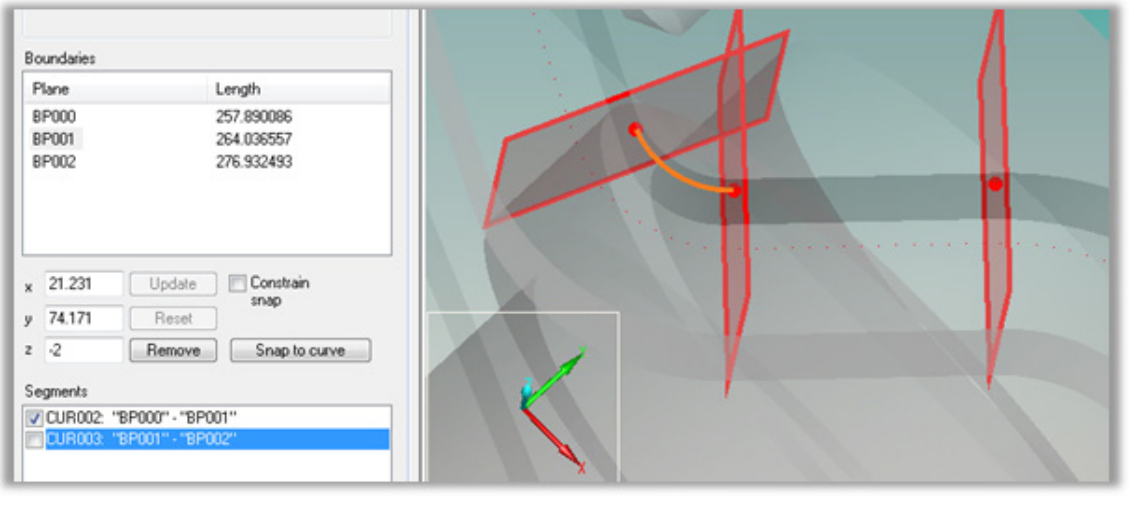
Select the ‘JOINS’ checkbox to show the points where the original curve can be split.

Click on the curve where you want your planes to be.



6.1 Verify the constructed curve

Checkboxes can turn on or off the displayed segments, so they can be visually verified. This step makes it possible to see which curve will displayed.



For further information on this functionality press F1 for MODUS Help.

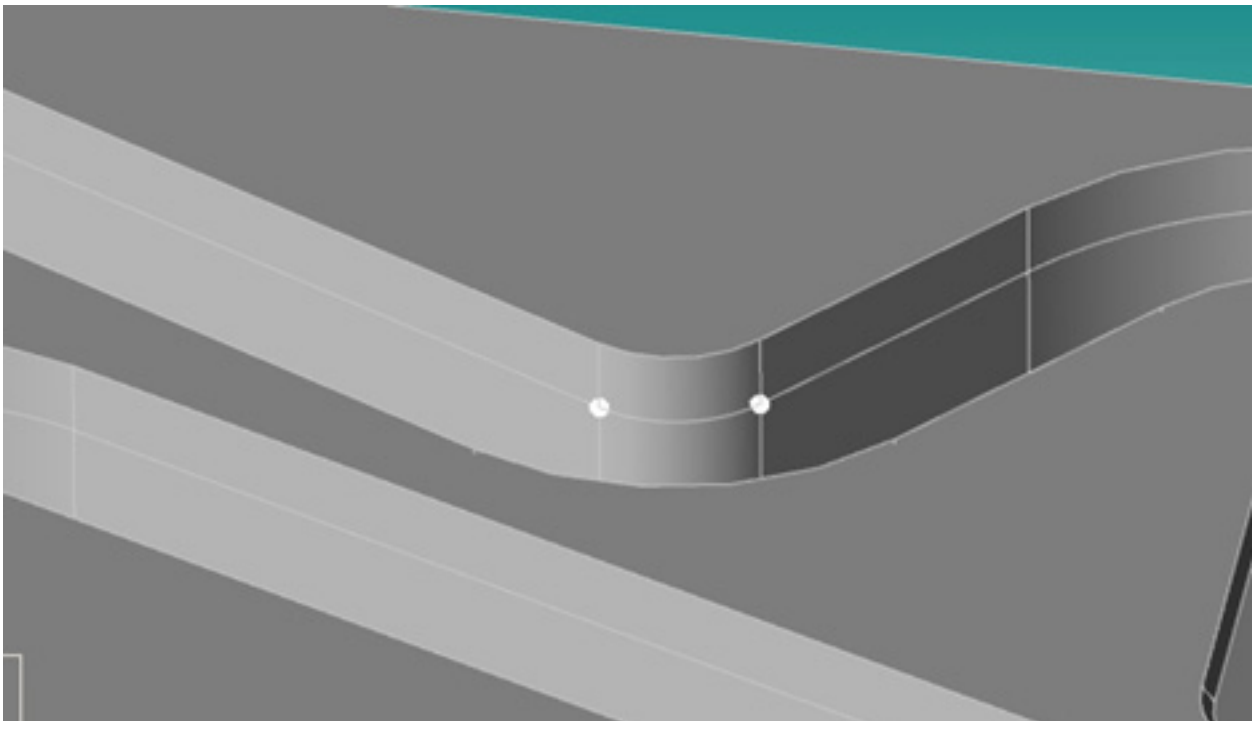
Sample DMIS code:

F(CUR002_Start)=FEAT/PLANE,CART,15.298,73.011,-3,0.914,-0.406,0

F(CUR002_End)=FEAT/PLANE,CART,21.235,74.176,-3,-0.68,-0.733,0

F(CUR002)=FEAT/GCURVE,CART,9.065,59.613,-3,0,0,1

CONST/GCURVE,F(CUR002),TRIM,FA(Outer_Curve),PLANE,ALL,F(CUR002_Start),F(CUR002_End)



Output the profile for the multi plane trimmed curve.

F(CUR002)=FEAT/GCURVE,CART,46.364,82.655,-2,0,0,1

Curve:CUR002

Line-Profile -0.010,0.001 -0.100 +0.100 ---*---

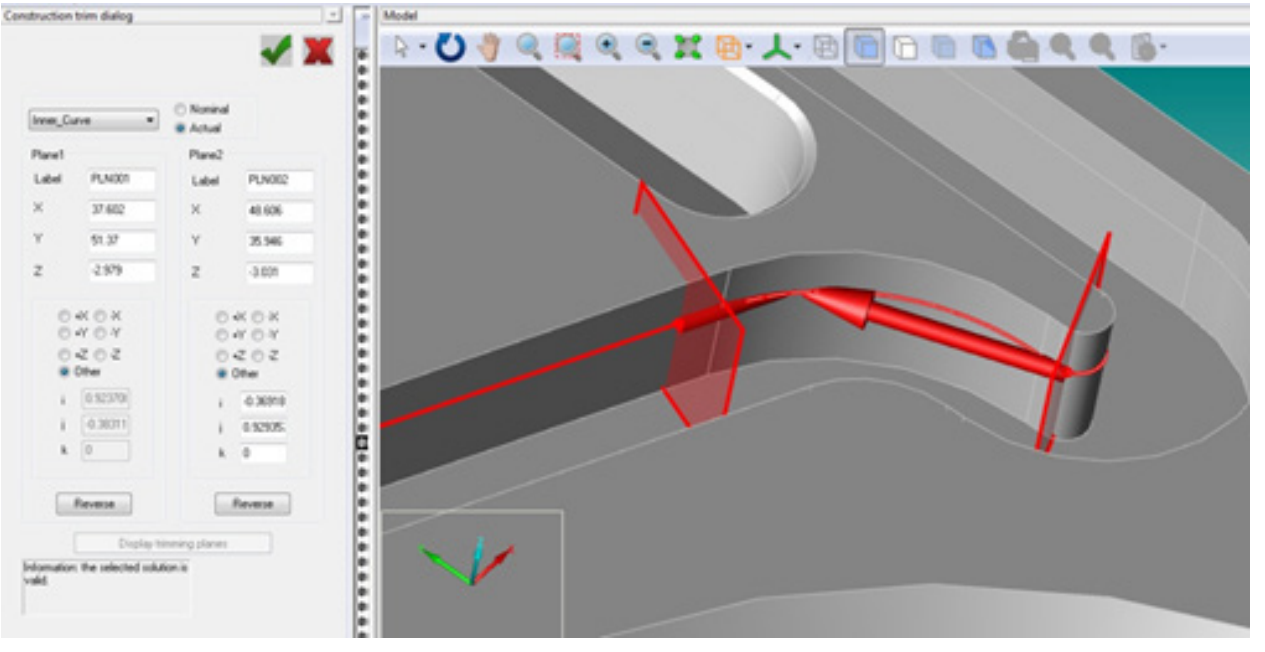
Nom.X	Nom.Y	Nom.Z	Act.X	Act.Y	Act.Z	Dev
15.298	73.011	-3.000	15.301	73.018	-3.000	-0.008
15.416	72.955	-3.000	15.420	72.964	-3.000	-0.009
15.535	72.902	-3.000	15.539	72.911	-3.000	-0.010
15.655	72.853	-3.000	15.658	72.861	-3.000	-0.008
15.776	72.807	-3.000	15.778	72.813	-3.000	-0.006
15.899	72.763	-3.000	15.901	72.767	-3.000	-0.005
16.022	72.723	-3.000	16.023	72.726	-3.000	-0.003
16.147	72.687	-3.000	16.147	72.688	-3.000	-0.001
16.273	72.653	-3.000	16.273	72.653	-3.000	-0.000
16.399	72.623	-3.000	16.399	72.623	-3.000	0.000

7 Trim using manually defined planes

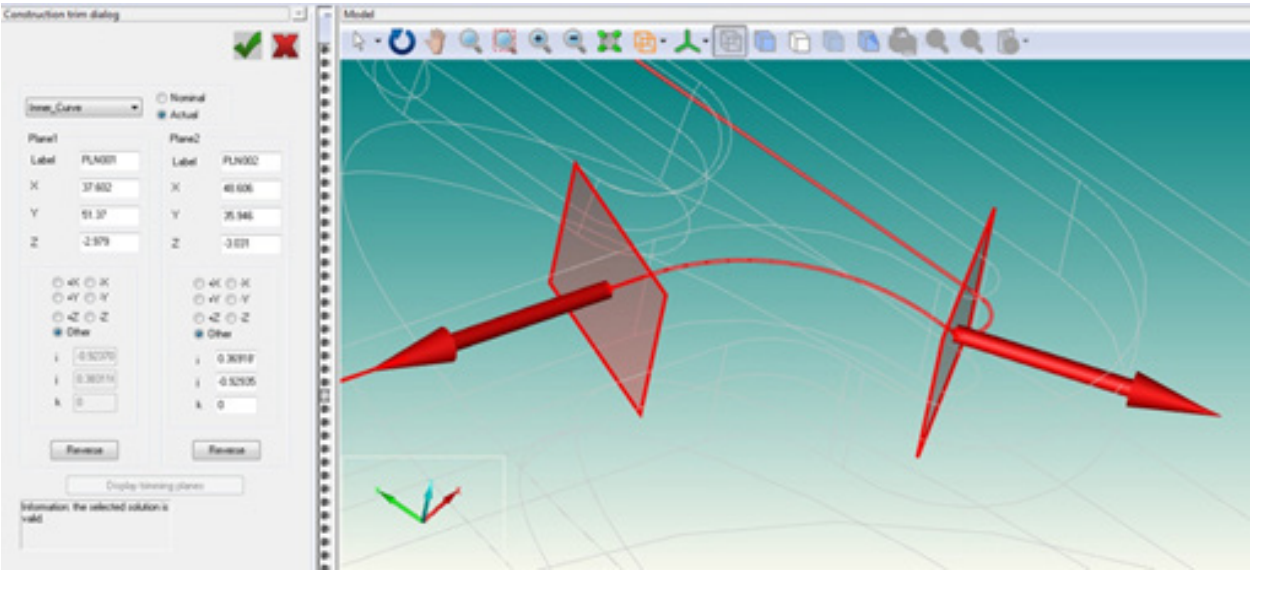
Trim can be used, which is only slightly different than the previous trimming algorithms.

Click: Construct, Curve and Trim

Click anywhere on the curve. Note that there is no need to select any checkboxes to show JOIN points between segments, as was required in the previous examples. The planes will appear at the location of the mouse click on the curve, regardless of the points where the segments join together on the original curve.



Click ‘Reverse’ on both planes in the dialog under the vector. The PLANE vectors will reverse 180 degrees. Also, the information pane at the bottom of the prompt will show if it is a valid construction.



Click the ‘Apply’ button and the curve on the inside will be constructed.

Sample code:

F(PLN001)=FEAT/PLANE,CART,37.602,51.37,-2.979,-0.924,0.383,0

F(PLN002)=FEAT/PLANE,CART,48.606,35.946,-3.031,0.369,-0.929,0

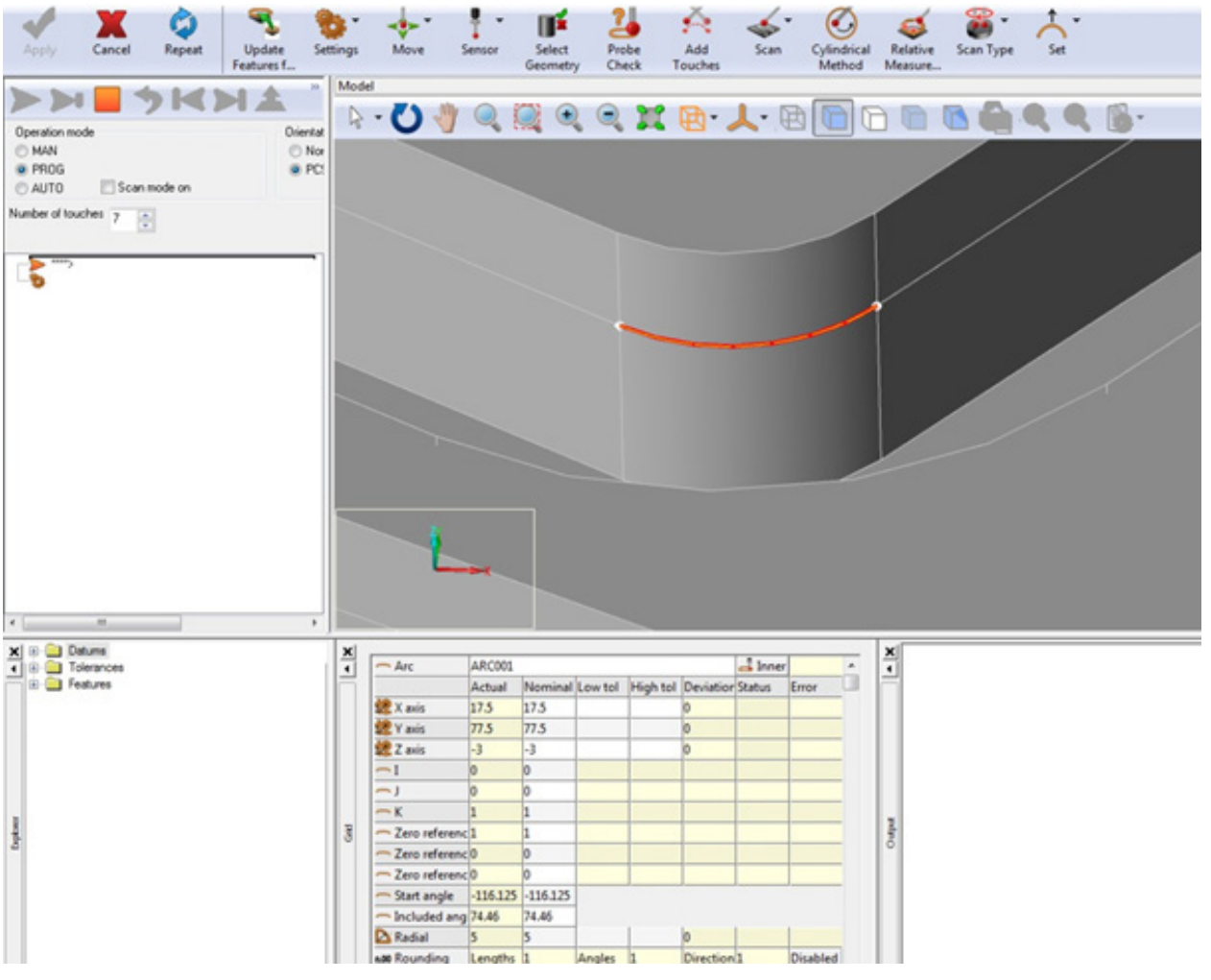
F(Curve_Inside_1)=FEAT/GCURVE,CART,19.428,60.66,-3,0,0,1

CONST/GCURVE,F(Curve_Inside_1),TRIM,FA(Inner_Curve),PLANE,ALL,F(PLN001),F(PLN002)

The curve can now be output as a profile with tolerance applied.

8 Construct an arc from a curve

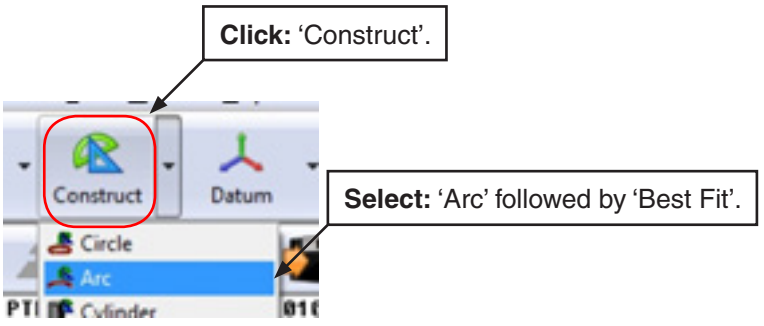
For nominal information, clicking on the curve and the grid will show the nominal data that is required, or use ‘Model - Query Geometry’.

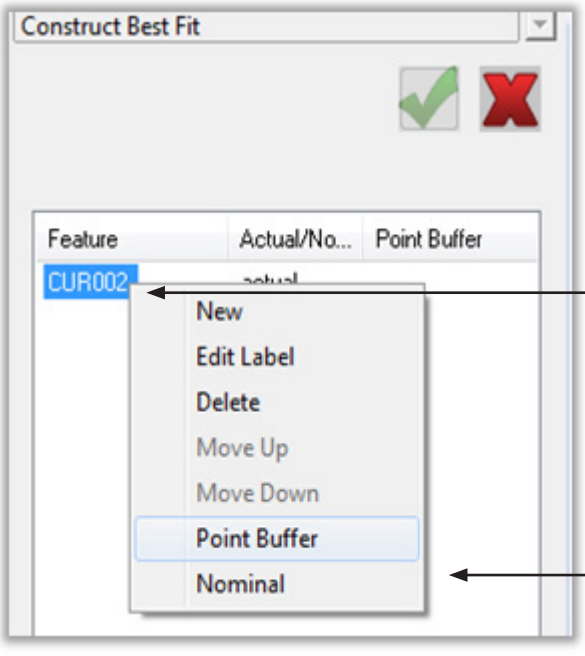


Nominal data: X = 17.5, Y = 77.5, Zero reference = 1, Start angle = -116.125, Included angle = 74.46 and Radius = 5.0

GUIDANCE NOTE: At this stage check whether an inner or outer arc has been defined to ensure that the correct nominal data is generated.

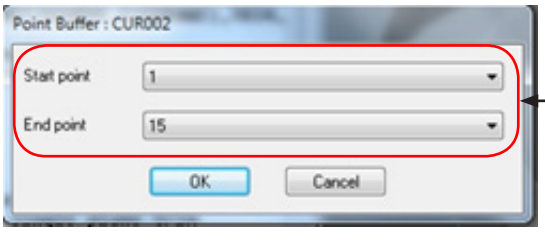
Click ‘Construct’ then select ‘Arc’ followed by ‘Best Fit’.



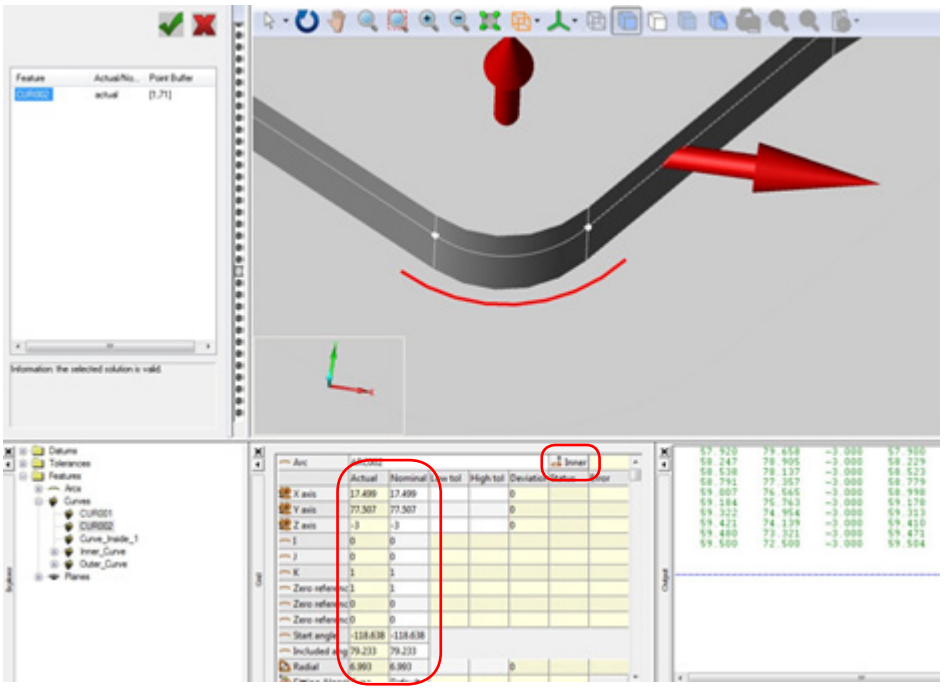


Drag the curve into the construction window from the Explorer window.

Next right click on the curve and select 'Point Buffer'.



Select the Start and End points.



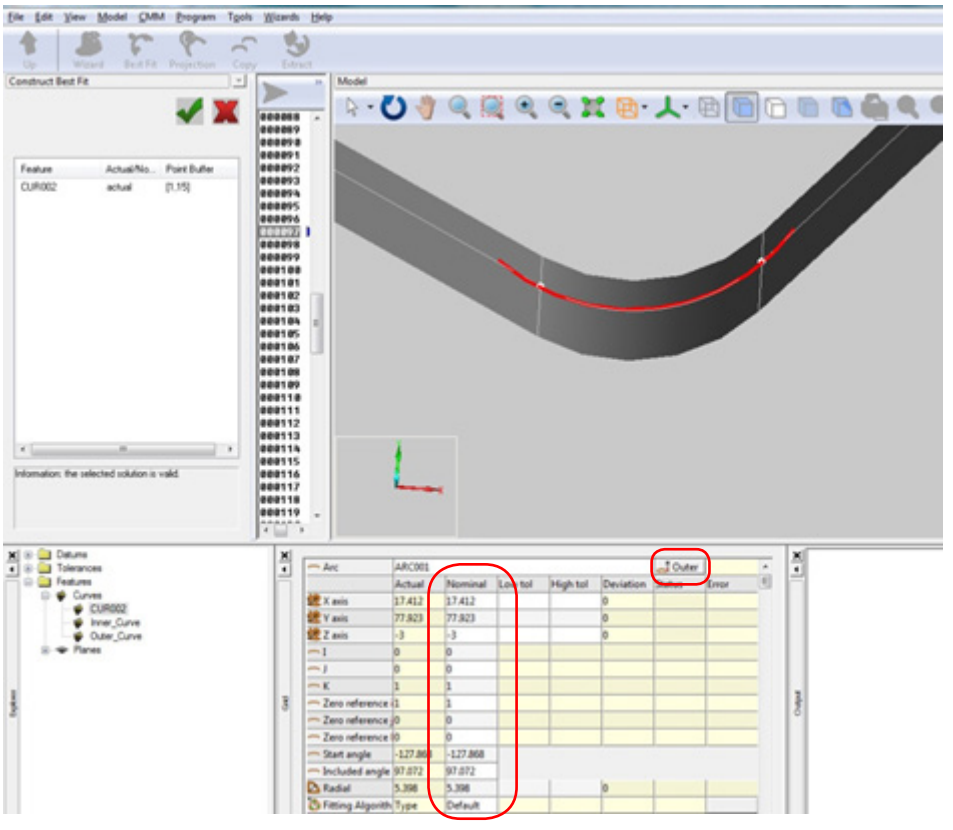
As can be seen the values found are not correct.

In this case 'Inner' has been selected for the radius calculation which is incorrect.

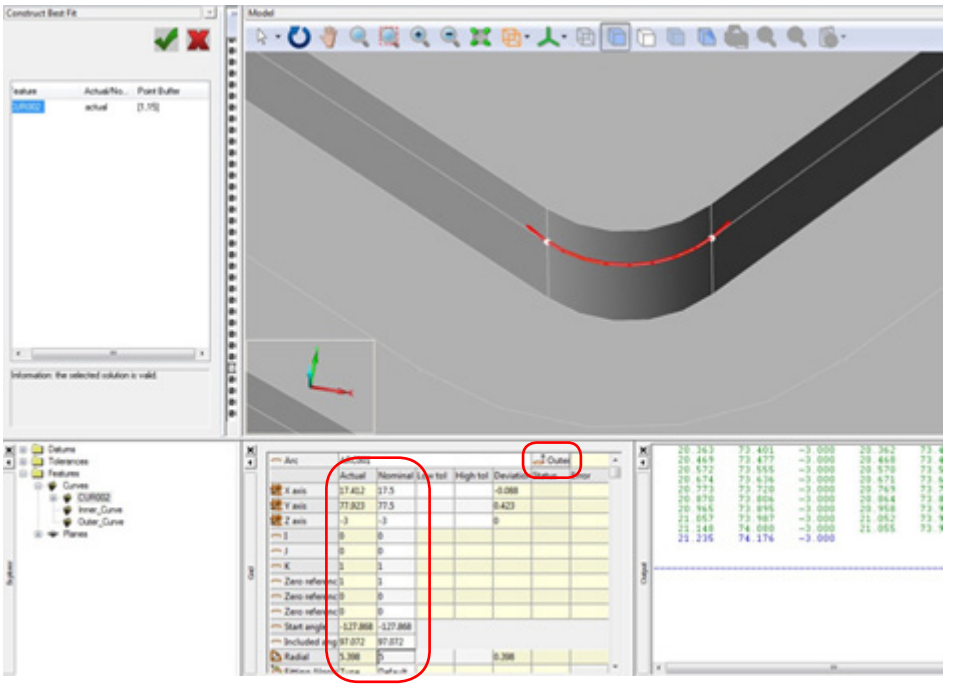
Nominal data: X = 17.499, Y = 77.507, Zero reference = 1, Start angle = -118.638, Included angle = 79.233 and Radius = 6.993

With ‘Outer’ now selected the new arc sits on the nominal curve.

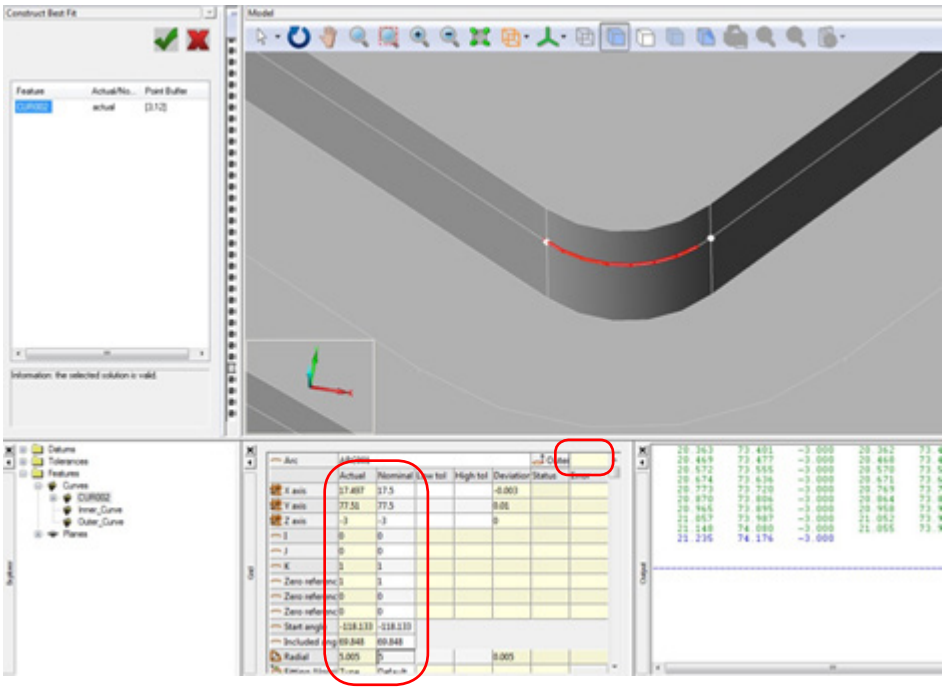
Here the actual Arc is longer than the Nominal



Enter the correct nominals.



From the above graphics it can be seen that the actual arc scan is longer than the nominal, so in this case the number of points need to be reduced in the buffer for the calculation.



After reducing the number of points from the Arc calculation the result is now much better.

8.1 Replace the maximum number of points taken with a variable

The number of scan points will change from one run to the next, it is important therefore to have some method of automatically changing the end point number / value.

To do this, an integer variable needs to be declared which will hold the total points scanned for any measured curve.

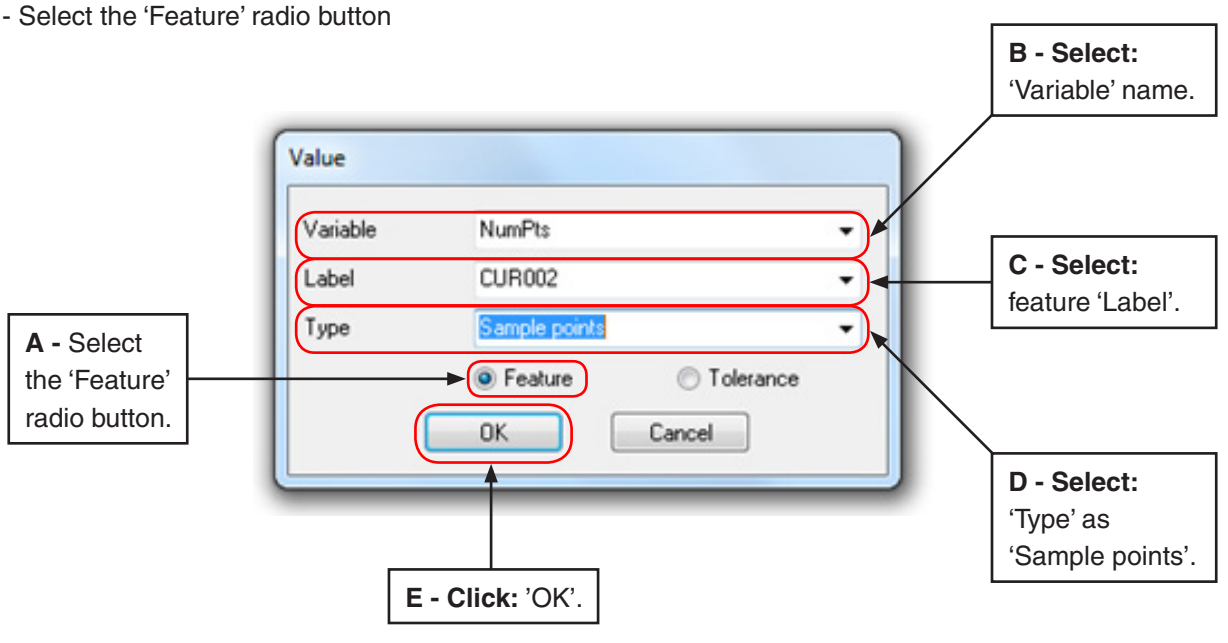
First, declare an integer variable and assign a value of zero as a reset :-

DECL/GLOBAL,INTGR,NumPts

NumPts=ASSIGN/0

Next, click 'High Level' and then select 'Value'. The purpose of this value assignment is to copy the number of points in a feature to the user declared variable.

A - Select the 'Feature' radio button



The variable will contain the total number of points in the specified scan.

Sample DMIS code:

NumPts=VALUE/FA(CUR002),PTDATA

Now replace the hardcoded value with the variable previously declared.

F(ARC001)=FEAT/ARC,OUTER,CART,17.5,77.5,0,0,0,1,5,-180,-74.46,-0.747,0.665,0

CONST/ARC,F(ARC001),BF,FA(CUR002)[1,NumPts]

The variable PTDATA used above is a MODUS system variable and always holds the total number of points taken for any multipoint feature.

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